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CCXXVII.—SISAL HEMP.

(*Agave rigida*, Mill.)

A remarkable development of the cultivation of Sisal hemp in the Bahamas has taken place during the last three years. The Governor, Sir Ambrose Shea, K.C.M.G., has enlisted such widespread interest, it might be termed enthusiasm, in the subject, that hemp-growing has become, for the moment, one of the most prominent of the new industries of the tropics. Frequent inquiry has been made at Kew, in regard to the plant yielding the best qualities of Sisal hemp, and information has been sought by official and other bodies to enable them to judge of the suitability of the plant for cultivation in other countries. The position taken by Kew in this matter is a very simple one. The various varieties and forms of *Agave rigida*, Mill, the species from which the several sub-species and varieties yielding Sisal hemp are supposed to have sprung, have been carefully studied, and living specimens have been added to the collections in the Royal Gardens. In this respect, the collections at Kew at the present time are probably as complete as any in the world.

Further than this an effort has been made to furnish from time to time in the *Kew Bulletin* such information as could be obtained respecting the methods of cultivation and the incidental conditions of the industry likely to be of general interest.* The Bahamas are

* The following articles have appeared in the *Kew Bulletin* on Sisal hemp and allied fibres from species of *Agave*:—

1887, March, p. 3, Sisal hemp (*Agave rigida*, var. *sisalana*). 1887, March, p. 10, Keratto fibre (*Agave Morrisii*). 1887, December, p. 5, Mexican fibre or Istle (*Agave heteracantha*). 1889, March, p. 57, Bahamas hemp (*Agave rigida*, var. *sisalana*). 1889, October, p. 254, Bahamas hemp (*Agave rigida*, var. *sisalana*). 1890, March, p. 50, Bombay aloe fibre (*Agave vivipara*). 1890, July, p. 158, Bahamas hemp (*Agave rigida*, var. *sisalana*). 1890, October, p. 220, Mexican fibre or Istle (*Agave heteracantha*). 1890, December, p. 273, fibre production in the Caicos. 1891, May and June, p. 133, Keratto fibre (*Agave Morrisii*). 1891, July, p. 175, Bahamas hemp (*Agave rigida*, var. *sisalana*).

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fortunate in possessing a soil and climate very favourable to the production of excellent fibre. They also have the great advantage of possessing, on the spot, immense quantities of plants of the best variety known to yield Sisal hemp. This variety is of rapid growth, and is easily handled. It has no side teeth to obstruct or retard the process of harvesting, and the people generally appear to have supported the action of the Governor to such an extent that the establishment of the industry is now within measurable distance of being accomplished.

The only drawback, so far, is the want of a machine that will enable the planters to extract the fibre in an effective and economical manner. As a last resort there is the somewhat crude and clumsy machine long used in Yucatan, but it is probable that before any lengthened period has elapsed a machine of a more suitable character will be forthcoming.

In the meantime, efforts are being made to establish a fibre industry in Florida, where, more than 50 years ago, plants of Sisal hemp were introduced and partially established by Dr. Perrine. A special Report prepared by Mr. Charles Richards Dodge of the Department of Agriculture at Washington [Fibre Investigations, *Report* No. 3, 1891], has lately been issued on the subject. In this Report an account is given of the distribution of Sisal hemp plants in Florida and the adjoining Keys, and it is recommended to utilise these as the starting point of a regular industry. Mr. Dodge says "what can be done in the Bahamas I have "reason to believe can be accomplished in this country [Florida] . . "We have the soil, the climate, and the plants. The combination "of capital and inventive genius with these conditions must work out "the problem, if indeed, the question is not already practically solved." A further account of the efforts made to establish Sisal hemp plantations in Florida is given later.

A small but promising effort is being made to grow fibre at some of the Turks and Caicos Islands, and plants obtained from this source and from Florida have been introduced into most of the West Indian colonies.

A short account has been prepared, mentioning most of the localities where plants of Sisal hemp are now found, and this account will afford useful material for enabling those who may wish to do so to decide as to the wisdom or otherwise of embarking in a fibre industry at the present time. At the close of the article, a statement is given of the average price per ton obtained for Sisal hemp in this country during the last 13 years.

Yucatan.

Information respecting the Sisal hemp industry in Yucatan has already been given in the *Kew Bulletin* for March 1887. Since that time an effort has been made to obtain direct from Yucatan a representative collection of the various Agaves cultivated in that country for fibre purposes.

Through the kind offices of the late Mr. Augustus Baker, Her Majesty's Consul at Vera Cruz, a large plant with a tall stem and flowering panicle was received at Kew in May 1890. The plant was dead on arrival, but it has since been prepared as a museum specimen, and is now deposited in Museum II. The dimensions of this plant are

as follows: length of stem (below the leaves) 4 ft.; circumference of stem 36 in.; number of leaves on stem, 50; length of leaves about 4 ft.; breadth of leaves 3½ in.; length of peduncle 14 ft. The branched panicle was received in an incomplete condition, but the total height of the plant as now existing is about 24 ft. The weight of the whole plant in a green state was probably not less than 2½ to 3 cwt. The leaves have the characteristic black terminal spine, and they are furnished throughout with small black teeth about 1 inch apart. This plant belongs probably to the variety *elongata* (*Agave rigida*, var. *elongata*). It is evident that in Yucatan the plants cultivated for fibre are largely composed of this variety. We learn, for instance, that in harvesting the leaves the Indian who cuts off the leaves is followed by an Indian woman, "who with a knife cuts off the spike or thorn-" tipped end and the thorny side of the leaf ready for the machine." In the case of leaves without teeth such as are borne by plants of the variety *sisalana*, it would be only necessary to cut off the terminal spine. Hence, while the latter variety yields fibre of equal if not better quality than the variety *elongata*, its leaves are more easily handled, and they require less treatment during the process of harvesting.

In addition to the large plant received from Yucatan there were received two lots of small plants. The first of these was received on the 31st May 1890, and represented apparently about five distinct kinds. The greater part consisted of plants of typical *A. rigida*, and a good number of *A. rigida*, var. *sisalana*. The others represented forms not easily determinable in a small state. A set, with the exception of the above, has been retained at Kew, and the plants will be determined later. The others were all distributed to the Botanical Gardens at Singapore, and to the Botanical Stations at Fiji and Antigua. The second lot of small plants from Yucatan arrived at Kew on December 16, 1890. On arrival there were 30 plants dead and 11 alive. The latter were, however, so small and sickly that, weakened by the cold to which they had been exposed, it was impossible to save them. This attempt to introduce a representative collection of Agaves from Yucatan, in spite of a considerable sum paid for expenses, was singularly unfortunate. It may be mentioned, however, that Merida, the head-quarters of the hemp industry in Yucatan, possesses only an unpaid Vice-Consul, who is but partially under the control of Her Majesty's Consul at Vera Cruz. It is due to the latter to state that he endeavoured to the utmost of his power to assist this establishment; and if he had not been so remotely placed the result would have been far more satisfactory.

Very little additional information, not hitherto published, has been received respecting the Sisal Hemp (Henequen) industry in Yucatan. The subject has already been very fully treated in the *Kew Bulletin*, and it is only necessary to add a description (with wood cut) of the method adopted for harvesting the leaves quoted in the *Report* of the Department of Agriculture, p. 25.

"This is done by the Indians, who are almost nude, with a stroke of the knife, or *machete*, at the rate of, for one hand, of 2,000 to 2,500 leaves per day. Following the Indian who cuts off the leaves is an Indian woman, who, with a knife, cuts off the spike or thorn-tipped end and the thorny side of the leaf, ready for the machine. One foreman was understood to say that it costs about 38 cents per 1,000 leaves to cut, prepare, and get the leaves to the cleaning machines. On all the large *haciendas* visited were little railways into the fields, upon which

on cars, drawn by mules or oxen, the henequen was taken to the mill, and the waste was taken away."

A Sisal Hemp Plantation in Yucatan.

As will be seen from the above wood-cut a Sisal hemp plantation should be systematically laid out, and to work it economically it is desirable it should consist of a tolerably large area. It has been insisted in regard to fibre plantations in Florida "that small plantations . . " . . will not pay. A large tract is necessary for the economical pro- " duction of fibre, so that the work of cutting the leaves and shipping the " fibre may be systematically continued for the greater part of the year."

As the weight of the green leaves is so large in proportion to the yield of fibre, their conveyance from distant parts of the plantation to the factory must involve considerable labour and expense. For instance, if every 100 tons of green leaves will yield only about $2\frac{1}{2}$ to $3\frac{1}{2}$ tons of dry marketable fibre, it is evident that an immense quantity of useless pulp has to be conveyed to the factory and disposed of as conveniently as the circumstances will admit.

Fibre estates should therefore be established on moderately level ground where light portable railways could be laid, or on moderately sloping ground converging on a single point where wire ropes could be used for sliding the leaves in portable bundles to the factory. The experience gained on sugar estates in cultivating large areas in the tropics and in conveying heavy perishable material to a central point would appear to be generally applicable also to Sisal hemp estates. As in sugar so in Sisal hemp, the advantage will ultimately rest with such estates as are able to reduce their working expenses to the lowest point and compete successfully with the produce of countries like Yucatan and the Philippines.

The *South American Journal* says that "the bulk of the henequen "grown in Yucatan is sent to New York, and that the export has grown "enormously. In 1875 the total value of the export from Yucatan, as "shown by the Custom House returns, did not exceed 710,124 dols., "since which period it began to attract greater attention, and in "1878 the figure almost doubled. The following shows the export of "henequen in each year from 1878 to 1889:—

"1878, 1,166,504 dols.; 1879, 1,287,375 dols.; 1880, 7,495,467 dols.; "1881, 2,284,389 dols.; 1882, 2,672,107 dols.; 1883, 3,311,663 dols.; "1884, 4,165,020 dols.; 1885, 3,988,791 dols.; 1886, 2,929,116 dols.; "1887, 3,901,628 dols.; 1888, 5,229,460 dols.; 1889, 6,872,593 dols."

It is mentioned as a curious circumstance that the market price of the fibre in New York increased almost *pari passu* with the increase of exports.

From Messrs. Crocker's American Statistics (quoted in Messrs. Ide and Christie's *Monthly Circular*, dated 15th January 1892) we find that the total importations of Sisal hemp into the United States during the years 1889–1891 were as follows:—1889, 237,736 bales; 1890, 230,800 bales; 1891, 286,700 bales. Of these latter we find 10,006 bales were re-shipped to the United Kingdom. The total importations into the United Kingdom (London and Liverpool), according to Messrs. Ide and Christie, were 20,296 bales. It is evident from this that the English market in regard to Sisal hemp is comparatively small.

As regards Manila hemp the result is very much the same, although in the first instance the bulk of the shipments are received in the United Kingdom. For instance, during the year 1891 there were received in the United Kingdom a total of 448,000 bales of Manila hemp. Of these there were re-shipped to the United States 175,919 bales, leaving 272,081 bales for consumption on this side. The total receipts of Manila hemp in the United States for 1891 (direct and *viâ* Europe) were 316,697 bales.

Taking the combined consumption of Sisal and Manila hemps (known generally as "white hemps"), we find the relative quantities taken on both sides of the Atlantic to be approximately as follows:—United States, 693,391 bales; United Kingdom, 292,377 bales.

Florida.

It is well known that plants of Sisal hemp were introduced to Florida from Yucatan, by Dr. Perrine in the years 1836 and 1837. It is to this introduction that Florida and the adjoining Keys owe their present supply of this valuable fibre plant. In a recent Report on Fibre Investigations (No. 3, 1891) issued by the United States Department of Agriculture, Mr. Charles R. Dodge gives a detailed account of the distribution of Sisal hemp plants in Florida and he supplies some new and interesting facts respecting their original introduction. In illustration we quote following paragraphs:—

"Mrs. Walker informs me that the first introduction of the plant from Yucatan occurred in the years 1836 and 1837, a few plants having been sent to the Royal Botanical Gardens of Cuba at the same time. Of the plants brought to Florida, part were taken to Indian Key and the others were planted upon "the Indian hunting ground," on the borders of Biscayne Bay. It is also stated that when these plants had multiplied to some extent the officers at Fort Dallas, at the mouth of the Miami

River, 12 miles from this locality, were in the habit of gathering the young ones to send to greenhouses in the north, and also to other posts where they were grown as ornamental plants. One of the results of this practice was to introduce the plant into many new localities in Florida, where it soon obtained a foothold. The plants set out on Indian Key multiplied very fast and a few years after the destruction of the enterprise, and the death of Dr. Perrine at the time of the Indian massacre, a schooner load of the young plants were gathered and taken away, though it is not stated where they went. * * *

"From this first introduction of the *Agave rigida* into Florida the plants spread rapidly, especially on the mainland, being commonly transplanted to the gardens of the early settlers of south Florida, chiefly for the sake of ornament. * * *

"These facts are considered worthy of mention, as showing that while every other evidence of former cultivation has long since disappeared the Sisal hemp, regardless of forest fires, weeds, and neglect, still holds its own and spreads year by year. * * *

"In the remarks of Dr. Engelmann, in Appendix A., the 'Yaxci' form, *Agave ridiga*, var. *sisalana*, is so fully described that there can be no doubt as to the plant that is meant. The late Dr. Parry, at one time botanist of the Department of Agriculture, found it in full bloom in February 1871, at Key West, and on the adjacent islands, and describes the leaves as "pale green but not glaucous, 4 to 6 feet long and 4 to "6 inches wide, generally smooth-edged, but here and there having a "few unequal, sometimes very stout and sharp teeth." This is the plant introduced into Florida by Dr. Perrine, for fibre culture, and considered by Dr. Engelmann to be "the most valuable of the fibre-producing Agaves."

"This is the form that I found growing along the entire southern coast of Florida, on my recent survey, from Cape Canaveral on the east side, around to Charlotte Harbour on the west or Gulf coast, and including many of the Keys. * * *

"The most interesting tract visited along this portion of the coast was found on the point perhaps a mile below the railroad station and wharf at Jupiter. Here I found a thicket of these Agaves, both the smooth and spined varieties, many of the plants having shot up their "poles" or flower stalks, which were covered with blossoms and young plants. * * * At Juno, about 10 miles farther south, at the head of Lake Worth, I found another fine nursery of perhaps 100,000 plants, the property of Mr. A. M. Fields, who is quite enthusiastic on the subject. Fully 50 per cent. of his plants are not *Agave sisalana*, however, but a species which was subsequently met with at many points along the east and west coast, as well as on the Keys, doubtless *Agave Mexicana*. [This determination requires verification. Ed. K. B.] At Addison's Landing, near Cutter, I found myself on the Perrine grant, though Mr. Addison informed me that the plants were chiefly growing on his own section. He estimates the number of old plants at about 15,000, growing without cultivation, and states that these have descended from the comparatively few plants which were on the place 25 years ago when he first occupied the land.

"The original planting, he states was done by Mr. Charles Howe who was associated with Dr. Perrine. He has both the spined and the smooth-leaved varieties, but makes the interesting statement that the latter "spreads" much faster than the former. As a matter of fact I found plants of the spined form, at this place exceedingly few and far between. * * * From this point I sailed southward, but found nothing of particular interest until Upper Metecombe Key was reached

where some of the most superb plants observed on the trip were seen. In one thicket, to which it was almost impossible to obtain access save at the expense of torn clothing and lacerated flesh, magnificent plants were seen where the tips of the leaves were two feet above a man's head.

"Indian Key, where Dr. Perrine lost his life, lies just below and beyond it is Lower Metecombe. Other Keys of the group are Lignum Vitæ, Shell Key, and some lesser ones, upon all of which the true Sisal hemp plants are found in abundance. A very rough estimate of the old plants in this group of Keys would be a hundred thousand, though in making the estimate I have relied largely upon the statements of the intelligent Bahamians living upon them. * * * Superb plants were examined by me at Fort Myers on the Caloosahatchie River and at other points, though there were no such thickets as seen on the Keys."

Bahamas.

The progress made in extending the cultivation of Sisal hemp in the Bahamas has been already duly noticed in the *Kew Bulletin*. In a recent report published by Mr. James M. Rae, and quoted in the *Bulletin* of the Botanical Department, Jamaica, No. 24, October 1891, it is stated that 12 months ago there were 4,199 acres of land in the Bahamas planted with Sisal hemp, and the aggregate number of plants actually put out was over two millions and a half. In addition to this it was estimated that there were over one million and a quarter plants in nursery beds; and from root suckers and bulbils (called pole plants) there would be available during the ensuing six months about two million plants more. According to this estimate the total number of Sisal plants actually existing in the Bahamas at the close of the year 1891, would not be far short of six millions.

The distribution of the various Sisal hemp plantations, and the methods of cultivation pursued in the Bahamas are described in the following extracts:—

"The people of Abaco, Harbour Island, Long Island, Rum Cay, Exuma, and Grand Bahama, where the largest number of Sisal plants are met with, have for many years past, been in the habit of making a small quantity of rope for home use, from the fibre they extracted from the leaf of the Sisal by the primitive method of bruising and maceration.

"In Abaco are the "headquarters" of the Sisal industry; for it is on this island, and some of its adjacent cays that the largest cultivations in the colony exist. Beginning at Hole-in-the-Wall, Mr. J. S. Johnson, * * * has 200 acres planted with 130,000 plants, some of which planted two years ago, have leaves over 3 feet long. Mr. Johnson has also two other cultivations on Abaco, namely, one at East Creek, Little Harbour, of 25 acres, with 21,000 plants, and another at Witch Point of 60 acres, with 31,200 plants. Cotton is being planted between the rows of Sisal.

"The Bahama Fibre Co., Limited, of which Mr. Abbott is the manager, has a field of 150 acres at Broad Creek with 73,000 plants, and another field of 108 acres at Joe Creek, with 62,000 plants. These two fields also contain 264,000 nursery plants. In addition to these the company has purchased a cultivation at Sweeting's Village, and another at Great Guano Cay, both of which were planted some years ago, and are yielding thousands of pole plants (bulbils) as well as a large number of suckers.

" Cherokee Sound has confined itself mostly to nursery planting, and I saw several thousands of such plants growing about this settlement.

" The Munro Fibre Company, managed by Mr. T. Trumble, commenced planting in August 1889, and now have 1,100 acres planted at Cocoa Plum Creek, with 654,000 plants, and 10 acres at Black Sound, with 7,000 plants. In addition to the field plants, there are also about 300,000 plants in nurseries.

" The company intend to plant their fields with cotton between the Sisal, and I understood Mr. Trumble to say that seed for this purpose had already been received from one of the southern States of America. The Company has also a factory at Black Sound, in which there are five of Death & Ellwood's machines worked by a 15 horse-power steam engine. These have been employed in cleaning Sisal leaves purchased from persons who have full-grown plants. The yield of cleaned fibre was ascertained to be about 4 per cent., but I could not help being struck with the large proportion of fibre that was wasted in the process. There can be no doubt that with the improved machinery which the demand must necessarily cause to be produced, the per-centage of cleaned fibre will be largely augmented.

" At Marsh Harbour * * * is the handsomest Sisal field I have seen. This was planted by Mr. Benjamin E. Roberts two years ago, and contains 140 acres, with 107,000 plants. * * * There were at least 25,000 suckers then in the field, and Mr. Roberts assured me that he had already removed 47,000 suckers. This field was being planted with dwarf cotton between the Sisal.

" At Hope Town, Mr. Thomas Russell, * * * has about 20,000 plants, some of which have been growing half a dozen years, and from these he expects to gather 100,000 pole plants (bulbils) this year, in addition to a large number of suckers.

" Another gentleman of the same name, now residing in Nassau, has a very fine nursery at Black Sound, containing many thousands of young plants . . . .

" *Propagation.*—The plant is propagated in two ways, namely, from the young plants furnished by the pole (bulbils), and the suckers which are thrown out from the roots. On the plant reaching maturity, a pole 15 to 20 feet in height grows out from its centre, on which a number of blossoms appear borne on arms which extend laterally from the upper part of the pole. In about six months after the appearance of the pole, bulbils that develop into young plants appear, varying in length from 2 to 4 inches, and in number from 1,000 to 2,500, and occasionally more. They are then gathered and set out 8 or 9 inches apart each way in nursery beds. In six months they will attain a growth of 8 to 12 inches, and they may then be transferred to the field.

" Suckers are plants which grow out from the roots of the parent plant, and in congenial soil are produced in 12 to 18 months. From this time, on to the third or fourth year, they appear in great numbers, many plants producing as many as 20 to 30 suckers during that period; after this they begin to decrease, until they finally cease to appear.

" With respect to the taking up and planting of suckers, I think it well, having regard to the speedy production of new plants, to call attention to a method which I have seen practised with very satisfactory results, viz., in removing a sucker from the parent plant, instead of cutting or breaking off the sucker only, to uproot entirely the white shoot at the end of which it is growing, and cut that off as near the parent trunk as possible. This shoot will be found to be jointed like a sugar cane. After the removal of the sucker, the shoot is cut up into

lengths of two or three joints. These bits are then planted in nursery beds, and in a short time each bit will produce as many suckers as there are joints. This method has the two-fold advantage of speedily increasing the supply of the new stock, and relieving the parent plant of the support of the suckers.

"*Field Planting.*—The system adopted by those who have engaged largely in planting varies. Some have planted as near as 6 feet each way, others, 7×7, 7×8, 7×9, 8×8, and 9×9. The Munro Company at Abaco, plant three rows 8 feet apart, with 7 feet interval between the plants, and leave a space of 12 feet between every fourth row The Bahama Hemp Company, Limited, under * * * Mr. Abbot, plant four rows 8×8, leaving a distance of 12 feet between every fifth row.

"Many planters have planted the spaces between the Sisal plants with some other crop, either ground provisions such as pigeon-peas, corn, &c., or cotton. This plan appears to be attended with excellent results, and is one that I cannot too strongly recommend, provided always that such auxiliary crops be not too thickly planted. The slight shelter they afford seems to be beneficial to the Sisal plants in their early growth, and tends to suppress the growth of weeds, thereby lessening the cost of keeping clean the field, beside yielding a remunerative crop. Sweet potatoes should not be planted in a Sisal field, at least not until the plants have attained a growth of a foot and a half to two feet, as the vines very soon cover the field and completely envelop the young plants, and retard their growth.

"*Effect of different soils and aspect on growth.*—I have both read and heard it broadly asserted that Sisal will grow and flourish anywhere, no matter how sterile or impoverished the land may be. My observations, however, do not confirm this. I do not mean to convey the idea that *really good rich land* is necessary for its successful cultivation, but merely to remove the impression, if such there be, that the plant will thrive in dry arid sand, or on rocky land void of soil. Worn out 'provision' and pine-apple fields appear to be well suited to its cultivation, while on broken, rocky surfaces, containing innumerable 'potholes' and crevices, in which is deposited the ordinary black or red earth, the plant luxuriates.

"*Crop.*—The length of time required for the production of the first cutting of leaves may, I think, safely be regarded as four years from the time of planting. A great deal depends upon the size of the plants when transplanted, but if they be of a suitable size, say from 12 to 15 inches, without doubt the leaves will attain a length of 4 to 5 feet and be fit to cut, well within the period named. I have seen thousands of plants with leaves from 2 to 3 feet long that had been growing only two years; and I have also seen plants, that I was told were three years old, from which leaves had been already cut.

"For the present, the yield per acre with us, can be only a matter of calculation, as the industry has been so recently begun; but sufficient positive experience has been derived to determine this point with approximate accuracy. The number of leaves cut from many plants of four years growth and upwards, has given an average of 40 leaves per plant, with an average weight of 1½ lbs. per leaf, and a yield of 4 per cent. of clean fibre. With an average of 600 plants to the acre, and 40 leaves * * * to each plant, the yield would be 36,000 lbs. of leaf and 1,440 lbs. of cleaned fibre. If the estimate be reduced to 35 leaves, there will be 31,500 lbs. of leaf and 1,260 lbs. of fibre, and this is certainly a very modest estimate. To

guard against all possible disappointment, however, the yield of fibre per acre can be safely placed at half a ton."

Considerable interest has lately been taken in endeavouring to trace the source from which the Bahamas have received their present supply of Sisal hemp plants. The Bahamas Sisal (or Pita, as it is called locally) is identical with that existing in Florida and the adjacent Keys. We have trustworthy evidence that the Yaxci Sisal plant (the variety with pale green and smooth or unarmed leaves, known as *Agave rigida*, var. *sisalana*) was introduced to Florida direct from Yucatan by Dr. Perrine in 1836 and 1837, that is about 55 years ago. Full information on the subject is contained in Senate *Document*, 30, dated Washington, March 12th, 1838; and in the *Report* of the Agricultural Department at Washington for the year 1869. We gather further particulars from Mr. Charles R. Dodge's *Report* on Fibre Investigations, No. 3, 1891, recently issued by the same Department. Mrs. Walker, Dr. Perrine's surviving daughter, states that the general planting of the Perrine grant (in accordance with the conditions imposed by the Government) occurred in 1846. For this purpose 36 families of Bahamas people were to be brought over to Florida "to go upon "the land to fulfil the condition of a settler upon each section. The "men came over to build their houses and plant their gardens prepara- "tory to bringing over their families when they were driven or "frightened away by the Indians and could not be induced to return. "It was about this time that the Agave was planted upon each section." After the death of Dr. Perrine and the practical abandonment of the plantations, the Agave plants spread rapidly and they were transplanted everywhere in gardens by the early settlers for the sake of ornament and possibly also to make hedges. It is also mentioned by Mrs. Walker that a schooner load of young plants was gathered and taken away but it is not stated where they went. The natural inference is that they were taken somewhere to the south, as it was found that they would not grow much further north than the spot originally intended by Dr. Perrine.

In 1871, the late Dr. Parry found the Agaves in Florida, and he describes them as having "pale-green but not glaucous leaves, 4 to 6 feet "long, 4 to 6 inches wide, generally smooth-edged, but here and there "having a few unequal, sometimes very stout and sharp teeth." This description exactly agrees with that of *Agave rigida*, var. *sisalana*, Perrine. The plants were then widely distributed at Key West and the adjacent coast. They have lately (1891) been carefully examined again by Mr. Charles Dodge with the result already given.

As the islands of the Bahamas are adjacent to southern Florida and there was regular intercourse between the two places about the time of the introduction of the *Agave* plants it was only natural to assume that the Agave now so abundant in the Bahamas had been originally introduced from Florida. They had found in the southern islands a warmer and more equable climate and had spread rapidly throughout the Archipelago. This view has, however, been strongly contested by Sir William Robinson, K.C.M.G., formerly Governor of the Bahamas, in the *Agricultural Record* of Trinidad, January 1891, p. 6. According to his Excellency's view, the Sisal hemp plant was introduced to the Bahamas by the late Mr. C. Nesbitt, a former Colonial Secretary, who "forty-five years ago, viz., in 1845, procured from Sisal, Yucatan, a "few hundred plants of this Agave and had them set out at his country "residence three miles from Nassau." Further "Mr. Nesbitt was

" much struck with the vigour of the plants when grown in New " Providence . . . In 1851 he reduced a great number of the " leaves of this plant into fibre and placed samples of them in the " Nassau Museum. At the same time he sent specimens of them to " England and received very favourable replies in regard to their value " from London."

Whether the whole of the Sisal plants now growing in the Bahamas have been derived from those first introduced by Mr. Nesbitt it is now impossible to say. It is evident, however, that this gentleman was fully aware of their economic value and he deserves great credit for the steps he took to bring them into notice.

The date of Mr. Nesbitt's introduction of Sisal plants into the Bahamas is given by Sir William Robinson as 1845. This would be about eight years after their first introduction into Florida by Dr. Perrine and about the time the Bahamians were engaged upon the Perrine grant to establish regular plantations.

This latter fact may or may not have a bearing upon the question. There is, however, another point worthy of consideration, and it is this : the chief variety of *Agave rigida* cultivated for fibre in Yucatan is apparently not the Florida and Bahamas plant, but one with glaucous leaves and armed with teeth. This is the form nearly always described as growing on Sisal plantations in Yucatan, and plants of this are almost invariably brought from Yucatan as the true thing. The plant, with smooth leaves and of a pale-green colour, was specially selected by Dr. Perrine from his personal acquaintance with it, while Consul for many years at Campeachy.

If Mr. Nesbitt also obtained this particular variety for the Bahamas direct from Yucatan without the special knowledge of its occurrence there, possessed by Dr. Perrine, the circumstance is a singular coincidence.

In the meantime, however, we must accept the claims so ably put forth by Sir William Robinson on behalf of Mr. Nesbitt, and trust that further investigation will confirm the fact that these islands owe to a Bahamas man the introduction of a plant which is calculated to produce so great an influence upon their future prosperity.

Turks and Caicos Islands.

These islands were once included under the Bahamas, to which group they geographically belong. At present they are under the Government of Jamaica.

In the report of a visit made by the Commissioner of Turks Island to Lorimers on Middle or Grand Caicos in July 1889, he states :—

" Shortly after sunrise on the morning of the 10th instant, I started to walk to *Bourbarra* about four miles distant, and on the way there I visited the Pita plantations which have been established by Mr. Alfred Stubbs, of Cockburn Harbour. This gentleman whose grandfather was the last slave-owner on the Caicos, whose house still stands, owns not less than seven to eight thousand acres on this Island (Grand Caicos) alone, and he is by slow degrees bringing portions of this under cultivation in fibre plants. His system has been to lease his land to the ' farmers ' (or ' planters ' as they call themselves) at the rate of about two dollars per acre per annum under the condition of their planting so many Pita plants each year. As the land they hold gets gradually taken up by the plants the planters move further afield.

"By these means he has succeeded in getting not less than 300 acres planted out, about half of which is now fit for cutting. His plants are placed too close to each other, and have not been kept clean, but they are strong and in good condition and would furnish leaves from 3 to 4 feet long. Some plants that I saw in the village enclosures which had received proper attention were much finer, the leaves being stout and well-coloured and not less than 4½ feet long.

"The fibre plants planted out by Mr. Stubbs are, I believe, the true '*pita*.' (Specimens have since been received at Kew, and they are undoubtedly *Agave rigida*, var. *sisalana*.) They are exactly similar to those found in Florida and the Bahamas. They have but one thorn and that at the end of the leaf. They have all been grown from imported plants. * * *

"The people are most anxious to start fibre cultivation on their own account, but I could not advise them to do so, until I can see my way to ensuring a sale for their leaves, as of course they could not buy machinery for themselves. Although the Government have but little land in that district, fit for provision farms, they have about 2,000 acres fit for Pita most of which is in excellent position for affording water carriage. This land I shall carefully preserve for the Lorimers' people, in case I am able to induce some persons here to form a company and import the necessary machinery."

The further development of a fibre industry at the Caicos Islands is fully described in the *Kew Bulletin*, December 1890; pp. 273–278. It appears that at West Caicos, Pita plants in good condition were found growing in the bush. The manager of a fibre company (lately formed) had land in an advanced state of preparation for planting purposes, and he hoped in October (1890) to set out plants of which upwards of 200,000 were already in hand. At East Caicos (Breezy Point) there were 15,000 to 20,000 acres suitable for Pita cultivation, and some 200 acres have been already cleared.

Jamaica.

As might be naturally expected, there has been considerable effort made to introduce plants of Sisal hemp for experimental trial in Jamaica. The present Governor of Jamaica, Sir Henry Blake, has taken a deep interest in the matter, and land has been established with fibre plants adjoining the Hope Gardens. The plants, numbering over 20,000, have made good progress, and the Director of the Botanical Department is in a position to supply suckers on a large scale to those anxious to start a fibre industry. There are large tracts of level and accessible lands in the plains of Jamaica suitable for growing Sisal hemp, and if the people had taken note of these circumstances some 8 or 10 years ago, they would have been able to take advantage of the recent high prices for white rope fibres, and have realised some share of the fortunes which have fallen to the people of Yucatan. At the present time the circumstances have greatly altered, and the advice given by Mr. Fawcett in regard to caution being necessary before embarking, at this late hour, upon a Sisal-hemp industry on a large scale is probably correct. In two or three years' time the extensive plantations in the Bahamas will be sending their produce to the market, and this, in conjunction with the expected increased returns from Yucatan, must tend to lower prices, unless something very unexpected occurs to create a greatly increased demand for Sisal hemp.

The steps taken to obtain Sisal hemp plants for Jamaica are detailed in the following extract from the Annual Report of the Botanical Department for the year 1889:—

"*Sisal Hemp.*—There is considerable demand in the island for plants of Sisal hemp. Three years ago I tried to obtain a supply of plants from Yucatan, but the planters there are so anxious to have a monopoly of a trade which brings them large fortunes that only through a special request from the Colonial Secretary to the British Vice-Consul at Progreso was I enabled to secure one dozen plants of the kind under ordinary cultivation (*Agave rigida*, var. *elongata*).

"Another variety (*Agave rigida*, var. *sisalana*), which is without the teeth on the edges of the leaves, has for some years been growing in the Bahamas, where it was probably introduced from Florida. A specimen of the fibre was shown at the Colonial and Indian Exhibition (1886) by his Excellency Sir Henry Blake, then Governor of the Bahamas. From a test that was made in the railway workshop by Mr. L. Mackinnon on this fibre extracted by Kennedy's machine, it appeared that it is at least as valuable as any fibre previously tested, and moreover, the leaves being without spines on the edges, are cheaper to work up. The Government of the Bahamas had forbidden the export of this plant (called "Pita") for a period of three years, but fortunately it has been found possible to get more than 20,000 plants from Turks Island, and a plantation has been formed at Hope Garden. Mr. Stoddart has superintended the planting. It is expected that it will be found possible to import a considerable number of this variety of the plant, and several applications have been received from planters for supplies of suckers. Considering that the price of Sisal hemp has (recently) fallen from 53*l.* per ton to 27*l.*, caution should be exercised in the investment of capital in the enterprise. I should hesitate to recommend its cultivation in any soil which is not suitable to it, and at the same time worthless for other cultivation."

A later account of the Sisal hemp plants at Jamaica is given in the *Bulletin* of the Botanical Department for October 1891, p. 15:—

"In order to encourage the planting of Sisal in Jamaica, the Government has imported lately from Florida 25,000 plants of the same variety as grows in the Bahamas. This is in addition to over 51,000 already supplied to planters, and to over 20,000 planted in the Hope Gardens. * * It is thus possible for any one to obtain a few plants for experiment at a very small expense, or in large quantities for laying the foundation of future fibre farms. * * *"

British Honduras.

As might be expected from the close contiguity of this colony to Yucatan—the two countries being, in fact, only separated from each other by the River Hondo—plants of the henequen, or Sisal hemp, are fairly common in British Honduras. Some experimental plantations have already been established in the northern parts of the colony, in the neighbourhood of Corosal, where the climate very closely resembles that of Yucatan. Quite recently Sir Alfred Moloney, with that enterprising spirit which has always characterised him in dealing with the resources of any colony with which he is officially connected, has forwarded to Kew specimens of leaves of two sorts of henequen, and of the fibre locally prepared from them. The specimens were labelled respectively Yaxci or Henequen verde (green henequen); and

Sacci (Sacqui) or Henequen blanco (white henequen). Both sorts were apparently varieties of *Agave rigida*, and referable to what is known at Kew as *Agave rigida*, var. *elongata*. The fibre prepared from these leaves arrived in a somewhat soiled and damp condition owing to the fact that it had been packed with the green leaves which had fermented in transit. The report made on this fibre by Messrs. Ide and Christie, dated 17th December 1891, is nevertheless of a satisfactory character :—

"We have been favoured with your note of the 15th instant with regard to the specimens of henequen fibre from British Honduras. We do not make much difference, commercially, between the white and green sorts. Both are very good style of fibre, quite of the Sisal hemp character, and they would be readily saleable to-day in London at 20*l.* to 21*l.* per ton. We think it should be possible to prepare them of a better colour, and with this accomplished a somewhat higher price might be obtainable. As we have mentioned in previous communications colour is of importance in all so-called 'white hemps.' Although up to the present only small lots of Bahamas Sisal have come to this market the colour and preparation have, as a rule, been excellent, and producers in British Honduras should likewise give them every attention."

Trinidad.

The following account of the introduction of Sisal hemp plants to Trinidad is given in the Annual Report of the Superintendent of the Royal Botanic Gardens, Trinidad, for the year 1891, p. 14.

"*Fibres.*—*Agave rigida*, var. *sisalana*.—During the year we obtained from Messrs. Reasoner Bros., of Manatee, Florida, 10,000 bulbils of this plant, and 2,000 from another source. Of this number 7,700 have been distributed to various applicants. The remainder, deducting usual losses, are still at the gardens.

"One thousand plants requisitioned by Tobago, and two thousand sent to the Convict Depôt are included in the above numbers.

"The plants arrived in splendid order in the form of small bulbils, *i.e.*, small plants without roots. They were placed in beds close together for convenience of culture, and as soon as properly rooted were transplanted at a wider distance, where they have thriven remarkably well. This is the plant which (it would appear from all accounts) is now being cultivated so largely in the Bahamas, and from which such 'great expectations' arise."

Windward Islands.

A good deal of interest has been shown by the Governor-in-Chief, Sir Walter Hely-Hutchinson, in the introduction of plants of Sisal hemp to the Windward Islands.

At the Grenada Botanical Station, the Curator, in a *Bulletin* (No. 9, September 1891), states that "there are in cultivation about 2 acres of Sisal hemp. These were planted out according to Stoddart's method, viz., 12 feet between rows, and 10 feet in the rows on a rocky hillside facing the west, and therefore fully exposed to the sun. For the sake of experiment, to half of this cultivation, light shade has been given by planting a row of corn between the rows of Sisal hemp, and it is worthy of notice that the plants so shaded have made far greater progress than those without shade. It would seem, therefore, that although the Sisal hemp plant may be extremely hardy, and require

no shade in its native habitat or in those islands where it has fairly become naturalized, yet in introducing its cultivation to these islands it is rather an advantage to give the plants slight shade, at any rate, during the first few months of its growth."

In the Report of the Curator of the Botanical Station at St. Vincent, dated the 1st August 1890, it is stated that "two thousand plants of Sisal hemp (presumably *Agave rigida*, var. *sisalana*) have been received from Florida. One hundred and thirty of these were found on arrival to be perfectly useless, and 1,600 were distributed. The remaining 270 were retained for the Botanic Gardens, where the largest plants were placed in the most suitable ground at my disposal, the rest being planted in nursery beds whence later on they will be transplanted."

In connexion with introduction of plants of Sisal hemp to St. Vincent it may be mentioned that in August 1890, Mr. J. H. Hart, F.L.S., Superintendent of the Botanical Gardens, Trinidad, drew attention to the existence of an *Agave* in St. Vincent, in the neighbourhood of Calliaqua, very similar to what may be regarded as the wild state of *Agave rigida*. It was furnished with teeth and it yielded very good fibre. Specimens of this plant are now under cultivation at Kew. It is evidently closely allied to the Sisal hemp plants, but the leaves are short, and seldom exceed $1\frac{1}{2}$ to 2 feet in length. The habit of the plant closely resembles that of *A. excelsa*, Jacobi. On account of the shortness of the leaves, and the occurrence of teeth, this plant is not likely to be in large demand as a fibre plant in any locality where the very long leaved and unarmed *pita* of the Bahamas and Florida (*Agave rigida*, var. *sisalana*) is obtainable. The St. Vincent *Agave* has also been noticed at Barbados, and probably it will be found in others of the West India islands.

In the Report of the Curator of the Botanical Station at St. Lucia for the year 1890, it is stated that "with the view of forwarding the establishment of a fibre industry in the island, the Government undertook the importation of 5,000 plants of Sisal hemp (*Agave rigida*, var. *sisalana*) from Florida. They arrived in good condition, and were at once planted in nursery beds to gain strength before the final planting out. Of these plants about 700 have been already sold, and orders have been booked for immediate execution; one for 1,000 plants and the other for 600 plants."

South Europe.

Various varieties of *Agave rigida* are found in the south of Europe and especially in the gardens of the Riviera. They are grown chiefly as ornamental plants, but large quantities of suckers and bulbils would no doubt be available if they were required for distribution to other countries. These plants have recently been studied on the spot by Mr. J. G. Baker, F.R.S., keeper of the herbarium and library at Kew, and a note upon them was given in the *Kew Bulletin* for January last, p. 4, which is reproduced :—

"*Agave rigida*, Miller. This is the most valuable and most variable of all the Agaves. It is common and quite at home in the Riviera gardens and flowering freely. I had an opportunity of studying its character and range of variation far better than I had ever done before, and of seeing several forms with which I was not previously acquainted. The commonest forms on the Riviera show the characteristic small distant nearly black teeth, and agree very well with what have been described

and figured as *A. Ixtli* and *A. ixtlioides* (Bot. Mag. t. 5893). In Dr. Hern's garden, situated just on the French side of the boundary gorge at St. Louis, I saw a form with leaves much thicker than usual (1½ in. thick at the base) and forming a less dense rosette. The plants called *A. Cantula* and *A. Rumphii* in the Riviera gardens are forms of *A. rigida*. Mr. Hanbury has just flowered a spineless form that agrees very well with the variety *sisalana* of Yucatan and Florida. I am quite satisfied now that *A. Houlletii*, Jacobi, is nothing more than undeveloped *sisalana* and the same holds good with a plant called *A. lævis*. One panicle of this species at La Mortola was producing copious bulbils. The peduncle, including the rhomboid panicle, does not reach a greater height than 12–15 feet. The bract leaves, like those of *Agave americana*, are small and distant as compared with those of *A. atrovirens*."

Mr. Baker expresses the opinion that *Agave lævis*, Todaro (not *brevis* as given in the Handbook of *Amaryllideæ*) a plant of which he found under that name at La Mortola is probably typical *Agave rigida*, var. *sisalana*. A fine photograph of this was recently sent to Kew by Dr. Todaro which is now in the Kew Herbarium. *Agave Candelabrum*, Todaro, may on further acquaintance prove to be *Agave rigida*, var. *elongata*.

West Africa.

In April 1890 there was received, through the Colonial Office, specimens of leaves of an *Agave* from Sherbro in the colony of Sierra Leone, West Africa, known locally by the rather singular name of Wild Sarsaparilla. The leaves were evidently those of one of the numerous forms of *Agave rigida*. They had small distant black teeth and the terminal spine so characteristic of the species. The leaves were thin and rigid in texture and of a glaucous green colour. It is evident from this that Sisal hemp plants have already been introduced into some parts of West Africa. The local name Wild Sarsaparilla cannot easily be accounted for. The thin long roots of some Aroideæ, somewhat resembling those of Smilax, have been exported from the West Indies as Sarsaparilla; but this is the first time that the name has been associated with any species of Agave. It is possible that introduced plants of *Agave rigida* may be found in other West African colonies if they were specially looked for. Their presence so far is interesting as showing how widely diffused many new world plants have become even in the less accessible parts of the old.

East Indies.

The species of *Agave* hitherto yielding commercial fibre in the East Indies have proved to be either *A. americana* or *A. vivipara*. Investigations undertaken by Kew during the last three years have shown that the Bombay (Aloe) fibre, of which an account is given in the *Kew Bulletin*, March 1890, pp. 50–54, is prepared from *Agave vivipara*, L. (A. Cantula, Roxb.) This fibre is almost unsaleable at the present time, and is quoted (January 15th, 1892) at 4*s.* to 11*s.* per ton. The stock at Liverpool is given at 5,136 bales. Plants of the species above-mentioned, received through the India Office, are now growing in the Kew collections. Manila aloe fibre (to be distinguished from the well-known Manila hemp prepared from *Musa textilis*) is also apparently prepared from *Agave vivipara*. This is quoted (January 15th, 1892)

at 14*s*. to 16*s*. per ton. Specimens of leaves of the plant yielding this fibre were lately received from Mr. Alexander Gollan, Her Majesty's Consul at Manila, and the above determination was confirmed. Fibre from *Agave americana* is prepared for local use both in India and elsewhere in the East Indies. It is probable that *Agave rigida* exists only here and there as garden specimens, and we are not aware of the occurrence of the unarmed Sisal plant *Agave rigida*, var. *sisalana* anywhere in the east. Plants of this have lately been distributed in small quantities from Kew to the Botanical Gardens at Calcutta, Madras, Singapore, Ceylon, and Mauritius.

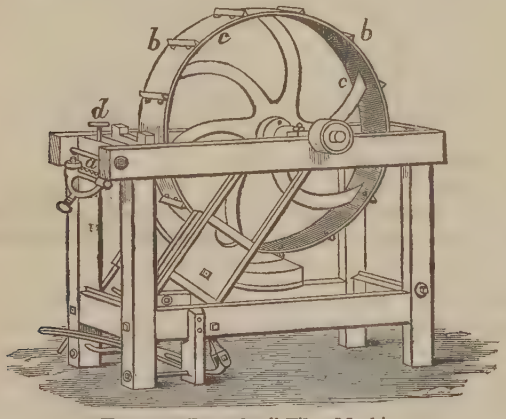
Recently about 1,000 plants were forwarded from Kew to the Botanical Gardens at Calcutta, and the Government of India has since taken steps to obtain a larger quantity for experimental trial in different parts of India.

Fiji.

At the request of the Governor, Sir John Thurston, who is keenly interested in the development of new industries in this remote British possession, plants of the various species of *Agave* yielding fibre have been forwarded for cultivation at the Botanical Station at Suva. In spite of the long time necessarily occupied in transit by way of Sydney the plants have arrived in good order, and the reports received of their growth is very satisfactory.

Fibre Machines.

Until very recently the only machine in use in Yucatan was a clumsy affair stated to be a native invention, called a "raspador." Rude as this piece of mechanism is, it is said that a native will clean 20 leaves a minute with it, though with a considerable per-centage of waste of fibre. While the raspador is said to have been superseded on some plantations, it is more or less generally used at the present time for extracting the immense quantities of Sisal hemp exported. The average work of one machine is claimed to be 7,000 leaves per day with two feeders or operatives.



Yucatan "Raspador" Fibre Machine.

The above is a respresentation of one of the Yucatan machines taken from the Report of the Department of Agriculture, U.S.A. [No. 3,

1891]. The following description of it is quoted by Mr. Charles Richards Dodge :—

"It is simply a wheel, like a 4-foot pulley, 6-inch face, with pieces of brass an inch square, and 6 inches long, running across the face about a foot apart. This wheel runs in a heavy wooden case. When working well it makes about 110 revolutions a minute. The leaf is put in through a small hole in the case, and being held by a strong clamp, is allowed to whip downward as the wheel moves around. A heavy block, like the brake of a car-wheel, is, by lever, brought to bear on the leaf, pressing it against the revolving wheel. In a second the pulp is crushed and thrown into a pit under the wheel, and the fibre is drawn back, one half of the leaf being cleaned quicker than one can follow the motions. The leaf is reversed and the other end cleaned in the same manner."

In the Bulletin of the Botanical Department, Jamaica, July 1891, a report is published of the results of experiments with the Weicher fibre machine at Jamaica. The machine was driven by steam power, and it required four persons to feed it and remove the fibre.

Amongst the leaves cleaned were those of the Sisal hemp plants, *Agave rigida*, var. *elongata*, and *Agave rigida*, var. *sisalana*. The results may be briefly summarised as follows: 115 leaves (weighing 185 pounds) were cleaned in 17 minutes. These yielded wet fibre weighing $20\frac{3}{4}$ pounds, and dry fibre weighing $8\frac{1}{4}$ pounds. The out-turn of dry fibre per day of 10 hours would thus be about 291 pounds.

At the Bahamas an American machine known as the Albee Smith fibre-cleaning machine was lately tried. An account given by the United States Consul at Nassau, dated July 10th, 1891, states that :—

" Considerable difficulty was experienced in getting the machine to run properly, owing to the fact that the steam plant used was defective, and the pulley and belts were not of the proper size, width, &c. But, despite these drawbacks, the operation of the machine was said to be decidedly satisfactory, and nearly all present were of opinion that, under proper conditions, the machine would very easily do all that was claimed for it, and that it was a most valuable improvement over all other machines in use in the colony. The new machine is entirely automatic. It grips the leaves continuously as fast as the operators can supply them, holds them firmly during the operation of cleaning, and delivers the fibre completely and beautifully cleaned at the further side. No reversing of the leaves or any part of the machinery is required. The operator simply supplies the leaves, and the machine does the rest. It is said to be capable of cleaning 50,000 leaves a day, extracting therefrom 3,000 lbs. of fibre."

It will be noticed that the exact returns are not here given. Those claimed for the machine by the makers are evidently purely conjectural, and, having regard to the tested results of other fibre machines, it is impossible to attach any importance to them.

Numerous other fibre machines have been brought before the public during recent years. Some of these are of undoubted merit, but it is evident that the expectations of cultivators of Agave plants have not yet been fully met. The conditions existing in Yucatan, where clumsy and wasteful machines have hitherto been adopted with apparent success, are of a peculiar character. Labour there is so cheap that cultivators can afford to carry on the industry under circumstances entirely unsuited to other parts of the world. Numerous improvements have, however, been lately made in English and American machines, and

there are good grounds for believing that the problem will be ultimately solved. The point requiring special attention is to ensure continuous action in feeding the leaves to the machine, and so save the time and trouble of reversing the leaves before the whole length can be cleaned. The automatic feeding attached to some machines whereby the leaves are presented sideways may accomplish this, but so far such an arrangement has not been tested for a sufficient time to judge of its practicability. The urgent demand which will soon be felt in the Bahamas for a satisfactory means of utilising the extensive fibre plantations established in those islands will call forth strenuous efforts on the part of those interested in the subject. At Mauritius a machine for extracting the fibre of *Furcræa gigantea* has been in use for some years, and it appears to give satisfactory results. This is fully described in the *Kew Bulletin*, May 1890, p. 98. The labour in Mauritius is chiefly supplied by Indian coolies.

Market Value of Sisal Hemp.

In view of the largely increased production of Sisal hemp in Yucatan, and the extensive planting which is taking place in the Bahamas, Turks Islands, Florida, and other places, it may be useful to review the prices which have been realised by Sisal hemp of good quality in this country during the last 10 or 15 years. By the courtesy of Messrs. Ide and Christie, fibre brokers, of 72, Mincing Lane, E.C., we are in a position to place on record the average prices per ton of Sisal hemp in the London and Liverpool markets for every month during the last 13 years from 1879 to 1891, both inclusive. The table attached speaks for itself. It may, however, be useful to point out that the price per ton has been as low as 17*l.* 15*s.* (in January 1886), and in March 1891 it rose as high as 56*l.* 10*s.* These are the minimum and maximum prices respectively during a period of 13 years. The average price for each of the 13 years, beginning with 1879, are as follows:—24*l.*; 27*l.*; 28*l.*; 28*l.*; 27*l.*; 21*l.*; 19*l.*; 21*l.*; 33*l.*; 37*l.*; 50*l.*; 30*l.*; 26*l.* The average price for the whole period is 28*l.* 10*s.* nearly. Prices ruled highest during the year 1889, when the average price was 50*l.* per ton. During the year 1891 the average price was 26*l.* per ton, or nearly one half of what it was two years previously in 1889. The last return issued by Messrs. Ide and Christie, dated the 15th January 1892, quotes Sisal hemp, spot value, at 23*l.* 15*s.* per ton. The market report is, "Sisal has again fluctuated, but closes at the "top, and 2*l.* per ton higher than when we last noticed." It is evident that the market value of Sisal hemp has shown considerable fluctuation of late years.

It has already been shown that the bulk of the Sisal hemp produced in Yucatan is shipped to the United States. The price paid for Sisal hemp in the New York market during the last 13 years is therefore necessary before we can take a complete view of the Sisal hemp industry for that period.

So far, we can only give returns of prices in the United States, published on the 31st December 1891, for the last three years as follows:—

1889, $8\frac{5}{8}$ cents per pound (40*l.* per ton); 1890, 6 cents to $6\frac{1}{4}$ cents (nominal) (28*l.* to 29*l.* per ton); 1891, $4\frac{1}{4}$ cents to $4\frac{3}{8}$ cents (20*l.* to 20*l.* 10*s.* per ton).

In the meantime the complete returns kindly placed at our disposal in regard to Sisal hemp in this country cannot fail to be of service:—

AVERAGE PRICE per TON of fair quality SISAL HEMP in the LONDON and LIVERPOOL MARKETS for 13 years from 1879 to 1891 (inclusive).

Months.	1879.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.	1888.	1889.	1890.	1891.
	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.
January - - -	23 0	32 10	28 0	27 10	28 0	22 10	19 0	17 15	27 10	36 0	50 0	40 10	28 10
February - - -	23 0	32 10	29 0	27 10	28 0	22 10	18 10	17 15	28 0	36 10	52 0	38 0	27 10
March - - -	22 0	29 10	27 0	26 10	28 0	23 10	18 10	18 10	28 10	37 0	56 10	32 0	28 10
April - - -	21 0	29 10	29 0	25 0	29 0	23 0	18 10	18 5	31 0	38 0	53 10	28 0	28 0
May - - -	21 0	26 10	29 0	27 0	27 0	21 0	19 10	18 10	32 0	35 0	53 0	26 15	28 10
June - - -	22 0	23 0	29 0	28 0	26 10	21 0	19 10	18 15	30 0	32 10	49 0	26 0	28 0
July - - -	22 0	23 0	27 10	28 0	27 0	20 0	18 10	19 15	30 0	29 0	50 0	25 0	27 0
August - - -	24 0	24 0	26 10	27 10	25 10	21 0	18 10	24 10	33 0	32 10	50 0	25 0	23 10
September - -	23 0	25 10	26 10	28 10	25 10	20 0	18 10	25 10	37 0	39 0	50 0	27 0	22 10
October - - -	25 0	25 0	27 10	30 0	25 10	19 10	18 10	24 0	40 0	39 0	50 0	26 10	22 0
November - - -	29 0	25 0	29 10	29 0	24 5	19 10	18 10	26 0	40 0	40 0	45 0	32 10	21 0
December - -	32 10	25 10	28 10	28 10	24 0	19 10	18 5	26 0	39 0	45 0	45 0	29 10	22 0
Average - £	24	27	28	28	27	21	19	21	33	37	50	30	26

CCXXVIII.—INSTRUCTION IN HORTICULTURE.

The funds at the disposal of the County Councils for technical education are being in some cases applied to instruction in Horticulture. Kew has been applied to for advice as to how this can be most effectively organised. The following correspondence is published for the information of those interested in the subject.

MONTAGU SHARPE, Esq., Vice-Chairman of the Middlesex County Council, to ROYAL GARDENS, KEW.

Technical Instruction in Horticulture.

DEAR SIR, Hanwell, W., December 13, 1891.

A SUB-COMMITTEE of the above council is now considering the best means of giving instruction in horticulture to the inhabitants of Middlesex who may care to avail themselves of it.

I have been requested to ask you to be kind enough to express your views on this matter, which will be of great assistance to the committee.

At present we have no plans before us, but I might say that for the parliamentary divisions of Brentford and Ealing we think (so far as other subjects are concerned) it would be advantageous to hold classes from time to time in each of the towns, the lecturer proceeding from one to another as soon as a course of instruction was finished. With apologies for troubling you.

I am, &c.

(Signed) MONTAGU SHARPE,
Vice-Chairman, Middlesex County Council.

The Director, Royal Gardens, Kew.

ROYAL GARDENS, KEW, to VICE-CHAIRMAN, MIDDLESEX COUNTY COUNCIL.

Royal Gardens, Kew,

SIR, 15th December 1891.

I AM sorry to say that I feel great difficulty in seeing my way with regard to the general problem of technical education, and horticulture seems to me to present peculiar difficulties. The cultivation of plants is an art which can only be acquired by practice, and therefore, it appears to me, cannot be taught in the lecture-room any more than painting or shoe-making. I know of no royal or theoretical road to the acquisition of a competent or even useful knowledge of the gardener's art except by beginning at the bottom and going through every operation, from the most elementary to the most difficult and refined. If an intelligent young man does that, and keeps his eyes open, he may become a successful gardener. But the mere reading of books and attendance on lectures will never, in my judgment, make anyone even a moderately competent gardener.

If you will look at the *Gardeners' Chronicle* for November 28, 1891, you will see a letter of Professor Huxley's which I reprinted. It ex-

presses in a very clear and forcible way with regard to agriculture the same views which, in substance, I entertain with regard to horticulture.

In the Royal Gardens at Kew, from the necessities of our organisation, we are unable to teach young men the rudiments of their profession. Those we expect them to have acquired before they come to us. What they gain at Kew is the opportunity of seeing a larger range of different kinds of cultivation than they can see in any private establishment. Besides this, we give them the use of a fairly-equipped horticultural library, and lectures on various branches of botany, and on such elementary physics and chemistry as more or less directly bear on horticulture. I very much doubt, however, whether these advantages add very much to the capacity of our men as gardeners. That they must gain for themselves by working in the houses under the skilled direction of able foremen. But I do not doubt for a moment that the time and pains our men bestow on self-improvement is of incalculable benefit to them, by stimulating and developing their general intelligence. The youthful years of most human beings is a period of receptivity. Knowledge is acquired often almost mechanically, like the multiplication table, or a colloquial knowledge of a language. When man's estate is approached or reached, the judgment comes into play. Most persons, unless they are congenital idiots, begin more or less to inquire and speculate as to the reasons of things. This prompts to study and inquiry as to the causes which bring about effects. It is this temper which we try to encourage at Kew. A man may know the rudiments of his art, and never be anything better than a journeyman. But if he begins to ask the why and the wherefore, then he is on the high-road to become a first-rate workman. And I know no art which affords a larger scope for the exercise of a lively intelligence than horticulture. A gardener tries to grow a plant, with the habits of which he is unfamiliar. He fails. He then, if he is a good man, begins to reflect. He brings to bear upon its culture the experience gained in treating similar "subjects." He tries different methods, and watches their effect: resting, watering, different kinds of soil, exposure to light, &c. The plant responds, and by seizing upon each indication of improvement which such a method of interrogation educes, the gardener ultimately finds the clue to success. The whole method is essentially scientific without making any profession of being so. If, however, a gardener, abandoning the experimental method, yields to intellectual indolence and is content to subject the plant to such physical conditions as he learns from a book exist in the plant's native country, then it may be pretty confidently predicted that he will be saved all further trouble by killing it.

I am afraid I have treated you to rather a long essay. But this was perhaps necessary to enforce my conclusion that I do not think the county council can do any good by giving lecture-room instruction in the art of horticulture. I have made inquiries, but I cannot find out that there is any class of persons in this neighbourhood that can be profitably reached by such an enterprise.

The labourers in market gardens are hardly likely to be induced to attend; and the scattered gardeners in the district would in all probability be, in all practical matters, better equipped than the lecturer.

In my opinion, the only course the county council can take is to drop the idea of devoting the funds at its disposal to technical and to apply them to secondary education. Lectures on such subjects as elementary physics, chemistry, botany, and vegetable physiology would aim at nothing more than carrying on general education on subjects not taught, or scarcely taught, in the primary schools. They would be

good as far as they go; would do no harm, and if the teachers were moderately competent, would almost certainly do some good.

I should add, that our Kew system, as a school, is to this extent defective, that it makes no provision for high-class instruction in fruit and vegetable cultivation; this, however, can be obtained at the gardens of the Royal Horticultural Society at Chiswick. There is a useful work open to the county council in obtaining facilities for passing young gardeners through Chiswick on much the same lines as obtain at Kew.

(Signed) W. T. Thiselton-Dyer,
Director.

Montagu Sharpe, Esq., to Royal Gardens, Kew.

Guildhall, Westminster,
17 December 1891.

Dear Sir,

I think it extremely kind of you to have taken so much pains over your reply to me, on the subject of horticulture in connexion with technical education.

I shall lay your letter before my colleagues, so that they may have the benefit of your advice.

All we can do at present is to draw up a report as to the best methods to be employed for giving instruction in some ten subjects which appear to be most suitable to the needs of the inhabitants of Middlesex generally.

The new council will have to determine to what extent it will proceed in the matter, but I feel sure it will give material assistance to science and art schools, which are already giving secondary education, and which includes, I think, some of the subjects you mention, such as elementary physics and chemistry.

The whole question is a most difficult one, and the council is much indebted to you for the valuable information you have been kind enough to give it.

I am, &c.
(Signed) Montagu Sharpe.

The Director,
Royal Gardens, Kew.

Horticultural Education.

[*Extract from the Gardeners' Chronicle, November* 28, 1891.]

While the subject of technical education in horticulture is occupying so much attention, we are pleased to be able to lay before our readers the views entertained on the subject by so highly competent an authority as the Director of the Royal Gardens, Kew:—

"You ask me to communicate to the pages of the *Gardeners' Chronicle*, something on the subject of horticultural education. This is undoubtedly a compliment, seeing that it obviously involves the not inconsiderable assumption that I know something about it, or, at any rate, have something to say on the subject which may be worth attention.

"I am by no means unwilling to do what I can. But though my own opinions on the matter are tolerably clear, the various aspects in which the question presents itself at the moment are, to tell the truth,

a little mixed. One has got to fix distinctly in one's mind whom, in the first place, one proposes to educate, and with what object. Some of my friends say gardeners; others 'younger sons:' and here I am reminded that the ladies must not be forgotten. Others, again, insist that intending colonists are the people to be taken in hand; some, on the other hand, suggest that the future peasant-proprietor is the person to be looked after with an eye to fruit culture and the *petite culture* generally. Lastly, there are those who would be content to disseminate a general interest in the subject by peripatetic and popular lectures, addressed to any local audience that may be inclined to attend them.

"It will be admitted that we have here a rather large field for discussion, and, unless we settle what particular item we are taking in hand, I have found that we are apt to get rather at cross purposes.

"I had got as far as this in the sorting out of my ideas, when the August number of the *Agricultural Gazette* for New South Wales came into my hands. Here I found a letter from Professor Huxley, on a subject closely analogous, which struck me as altogether admirable. It has made a boomerang-like flight to the Antipodes, and back again. But it is evidently none the worse for the journey, and I do not see why I should not launch it on its travels again:—

In the course of a paper on technical education, before the Easingwold (England) Chamber of Agriculture, on April 10 last, Mr. J. Harrison read the following letter from Professor Huxley, which appears also in the *Agricultural Gazette* of England:—

"I am afraid that my opinion upon the subject of your inquiry is worth very little, my ignorance of practical agriculture being profound. However, there are some general principles which apply to all technical training. The first of these, I think, is that practice is to be learnt only by practice. The farmer must be made by thorough farm work. I believe I might be able to give you a fair account of a bean plant, and of the manner and condition of its growth; but if I were to try and raise a crop of beans, your club would probably laugh consumedly at the result. Nevertheless, I believe that your practical people would be all the better for the scientific knowledge which does not enable me to grow beans. It would keep you from attempting hopeless experiments, and would enable you to take advantage of the innumerable hints which Dame Nature gives to people who live in direct contact with things. And this leads me to the general principle which I think applies to all technical teaching of school boys and school girls, and that is, that they should be led from the observation of the commonest facts to general scientific truths. If I were called upon to frame a course of elementary instruction preparatory to agriculture, I am not sure that I should attempt chemistry, or botany, or physiology as such. It is a method fraught with danger of spending too much time and attention on abstraction and theories, on words and notions, instead of things. The history of a bean, of a grain of wheat, of a turnip, of a sheep, of a pig, or of a cow, properly treated, with the introduction of the elements of chemistry, physiology, and so on, as they come in, would give all the elementary science which is needed for the comprehension of the processes of agriculture in a form easily assimilated by the youthful mind, which loathes anything in the shape of long words and abstract notions, and small blame to it. I am afraid I shall not have helped you very much, but I believe that my suggestions, rough as they are, are in the right direction.

Yours, &c.
(Signed) T. H. Huxley.

Now, with every word of this, I, for my part, cordially agree. It is just what I meant to say, only said a great deal better. I do not propose to employ it as a stalking-horse, but I am glad to use it as a text for some further observations on a future occasion a piece of sound, vigorous common sense.—*W. T. Thiselton-Dyer, Royal Gardens, Kew.*

CCXXIX.—BOTANY OF GAMBIA DELIMITATION COMMISSION.

A Report on the Botanical collections made by Dr. Brown Lester, Medical Officer to the Gambia Delimitation Commission, was published in the *Kew Bulletin* for October and November, 1891, p. 268.

By the courtesy of the Secretary of State for the Colonies there has been received at this establishment an extract from the French *Journal Officiel*, dated 28 December 1891, communicated to the Foreign Office by Mr. Edwin H. Egerton, C.B., Her Majesty's *Chargé d'affaires* at Paris. This extract contains the Reports of the French members of the Gambia Delimitation Commission. A translation of the Botanical section of these Reports is reproduced in the *Kew Bulletin* for the purpose of supplementing the notes supplied by Dr. Brown Lester.

The scientific names in brackets have been added at Kew. A few of the plants mentioned under local names have not been identified. For the most part the plants consist of well known West African species with a few introduced plants and cosmopolitan weeds.

The flora of the regions traversed differs also but slightly from that of Senegal, particularly in the north of Gambia. But the general aspect of the vegetation is not the same in the north and in the south. In the north of Gambia (Niom, Rip, &c.), with the exception of a few *Ficus*, Baobabs (*Adansonia digitata*, L.), and Caïl-cedras (*Khaya senegalensis*, Juss.), of considerable height, no great trees are met with, especially in forests. Outside the villages, surrounded by cultivation, there is everywhere a thicket of high grass, often very dense, with trees, nearly all of small dimensions, scattered more or less thinly through it. In the south (Combo, Fogni), great trees abound. Around the Diola villages there are real forests of enormous *fromagers;* elsewhere the forests consist of most varied species, palms, Caïl-cedras (*Khaya senegalensis*, Juss.), Figs (*Ficus*, sp.), Baobabs (*Adansonia digitata*, L.), tied together by tangled lianes, often very strong, one of the commonest of these is the caoutchouc liane (*Landolphia*, sp.). Bamboo woods of often considerable extent cover Combo and the west of Fogni. The principal species which I have remarked are the following :—

Millet (*Pennisetum typhoideum*, Rich.), the staple food of the natives; round the villages there always exist fields of greater or less extent. Rice (*Oryza sativa*, L.) is only cultivated in Combo and Fogni.

Bamboo, very abundant in the south of Gambia, serves many purposes. The stems (sometimes exceeding 33 feet in height) cut into strips and interwoven by the natives (Mandingoes) form the fences of the squares and villages; entire they are made into handles for

many instruments, and also serve for the framework of the roofs of the huts.*

Ronier (*Borassus flabelliformis*, L.) very abundant in Combo, where in many places it forms forests of considerable extent, often very dense. The very hard wood is used for building purposes.

Palmiste (probably *Elæis guineensis*, Jacq.), found more abundantly in the west of Fogni and on both banks of the Gambia as far as McCarthy's Island and beyond; it yields palm-wine, palm-oil, and *Chou-palmiste*.

Cocoa-nut (*Cocos nucifera*, L.) We only met with this at Bathurst; it has probably been introduced there.

Doum Palm (*Hyphæne thebaica*, Mart.), a palm whose stem bifurcates at the base, then at a certain height branches into three. (McCarthy's Island.)

Calamus scipionum. The stem of this, stripped of its leaves, furnishes rattan (on the edges of the creeks and in damp lowlands). [The plant referred to is probably a species of *Calamus*, but not *C. scipionum*. This furnishes the Malacca cane of commerce and is a native of Siak.]

The Dwarf palm (*Palmier-nain*) is abundant on river banks, by the side of mangrove swamps.

Castor Oil plant (*Ricinus communis*, L.), is met with nearly everywhere; rarely exceeds 6 to 10 feet in height.

The Manihot root (*Manihot utilissima*, Pohl.), is eaten by the natives and cultivated throughout the Gambia region.

The Silk tree (? *Eriodendron anfractuosum*, D. C.), also grows throughout the Gambia region; in Rip a large number of trees occur in the vicinity of the villages.

The Oleander (? *Nerium Oleander*, L.), does not grow in the brushwood; there are a few plants at Bathurst.

In the thickets and in the fields there occurs a small herbaceous Crucifer from 18 to 24 inches in height; the flowers generally are rose coloured, but sometimes white, and are produced from November to February.

A Mallow, similar to that found in Algeria, grows in the neighbourhood of Cape St. Mary.

L'Oseille de Guinée (*Hibiscus Sabdariffa*, L.), in the neighbourhood of the Djinnack Creek, grows in hedges near the villages (Niom) and in the forests.

Cotton (*Gossypium barbadense*, L.), is in very great abundance near the villages; it attains sometimes 40 inches in height. [The following other species of *Gossypium* occur in tropical Africa:—*G. arboreum*, L., and *G. herbaceum*, L.]

Baobabs (*Adansonia digitata*, L.), of all sizes are seen round the villages and in the brushwood; less abundnant in Fogni.

A few so called Wild Roses are found in the Fogni forests.

[* The common bamboo of tropical Africa, according to Munro, is *Oxytenanthera abyssinica*, Munro. This has stems 25 to 50 feet in height and 1½ to 3 inches in diameter at the base, the colour is described as *glauco-pruinosus*. The leaves are linear or oblong-lanceolate 6 to 7 inches long and half to one inch wide. It has been noticed in West Africa at Angola, Pungo and Andongo, by Welwitsch; at Accra (Sierra Leone) by Vogel; and at Nupe by Barter. Munro adds that this fine, distinct-looking bamboo seems to have a wide range in Africa extending into both tropics. Barter says that it was the only arboreal grass he had seen (in Baikie's Niger Expedition), and that the stems were used to pole canoes, and the smaller ones as shafts for spears.]

The Néou (*Parinarium macrophyllum*, Sabine), is a tree abundant in Niom, Rip, and Combo ; the fruit has a floury sweet mesocarp, and is used as food by the natives.

The Kevert (probably *Chrysobalanus Icaco*, L.) (in many valleys of Fogni). The fruit of this tree is borne in racemes, red-brown when ripe, with a fleshy sugary mesocarp.

The Cad (probably identical with "Cadda" *Cæsalpinia* near *C. coriaria*), the Wolof name for an Acacia with which many plains in Fogni are nearly exclusively covered.

Cassia fistula, L., is very common everywhere.

The Dank (*? Zizyphus*, sp.) grows throughout the region; its drupaceous sweetish fruit is eaten by the natives.

The Hire; the very hard wood of this tree could be used for building purposes.

The Néto (probably *Parkia biglobosa*, Benth.) The Mandingoes use the bark of this as a specific for toothache.

The N'gagna (probably *Mucuna pruriens*, D.C.). The pulp of the pod is covered with stiff short hairs, which, on contact with the epidermis, produce a violent itching accompanied by erythema.

The Ground Nut (*Arachis hypogæa*, L.) is cultivated everywhere; it is the most important commercial product of the Gambia, whence every year from 16,000 to 18,000 tons are exported.

Indigo (from *Indigofera tinctoria*, L. and other species), is cultivated everywhere; it also grows in a wild state along the steep river banks of Upper Gambia. It is the only dye known to the negroes.

The Tamarind tree (*Tamarindus indica*, L.) is found at Bathurst and in the plains of the river.

The Acajou à pommes (probably *Anacardium occidentale*, L.) is somewhat rare in the brushwood.

The Banana (*Musa sapientum*, L.) is found round the Mandingoe villages throughout Combo.

The Calabash (*? Cucurbita maxima*, Duch.), gourd (*? Lagenaria vulgaris*, Ser.) and several varieties of cucumbers and other *Cucurbitaceæ* were noticed.

Caïl-cedra (*Khaya senegalensis*, Juss.) throughout the south of Gambia ; rarer on the right bank ; it often attains considerable dimensions.

Lemon (*Citrus Medica*, var. *Limonum*, Brand.) found at Bathurst and Combo, but is not very common.

The Orange (*Citrus Aurantium*, Riss.) appears to have been imported by the Mandingoes; their villages, especially in Combo and the west of Fogni, are surrounded by orange trees, many of which are very large and bear excellent fruits.

Datura Stramonium, throughout the region.

Nightshade (perhaps *Solanum nigrum*, L.) rare in Rip and Niom.

Capsicums (*Capsicum annuum*, L., and *C. frutescens*, L.) are cultivated by the natives and used for food.

A Tomato (probably *Lycopersicum esculentum*, Mill.) with spherical fruits the size of a cherry is grown.

Diakoto, an herbaceous *Solanaceæ*, with a fruit like that of the tomato of Europe, is used for food by the natives.

Ficus, a large number of species are met with throughout the region.

Papaw (*Carica Papaya*, L.) Very common in the villages, those of Fogni excepted.

Fromager is the tree of the Gambian region which attains the largest dimensions.

Karité (*Butyrospermum Parkii*, Kotschy) met with everywhere, except in central Fogni.

L'Inée (*Strophanthus*, sp.) Very common, particularly in Niom and Rip; the two species, *S. hispidus* and *S. Kombe*, grow in the woods in the shade of the trees, which serve them for support.

Jujubier (probably *Zizyphus jujuba*, Lam.) in Rip and Sabac there is a wild variety; the Wolofs call it Sidem.

A large number of species of Convolvulus (*Ipomœa*, sp.) are found, many of which bear beautiful flowers. In the marshes are white water-lilies, rushes, and arums. In damp spots, mosses, fungi, and herbaceous ferns, &c. Finally the Caoutchouc liane (*Landolphia*, sp.) (in the forests of Fogni, especially towards the south). In Gambia the trade in this is growing more and more important.

CCXXX.—BANANA DISEASE IN FIJI.

A short account of the disease affecting banana plants in Fiji was published in the *Kew Bulletin*, December 1890, p. 272. Specimens of stools were received at Kew last year, but the results of an investigation of them were purely negative. Mr. Arthur E. Shipley, F.L.S., to whom they were submitted, was unable to detect anything abnormal in the roots, stems, and leaves. There appeared to be no trace in the specimens, as received in this country, of nematode worms, of insects, or of any fungoid pest. As indicated in the letter addressed by this establishment to the Colonial Office, dated 13th November 1890, Sir Ferdinand Von Mueller, adopting the view that the disease was possibly produced by a nematode worm, recommended, failing success with various insecticides, ploughing the land, leaving it fallow, and alternating some other crop. The ground could then be re-planted with banana "stools" from an unaffected locality.

The view that the disease was caused, in part at least, by nematode worms, is apparently confirmed by an investigation with fresh material undertaken by Mr. N. A. Cobb, at Sydney, New South Wales. The results are published in the *Agricultural Gazette* of New South Wales, October 1831, p. 622. The Fiji plants were found to be affected with aphides, which, however, could not be proved to have done much damage. In the root-stock a fungus was found, and the fact that this does some damage has been established. The presence was shown by a brown discolouration of the interior of the root-stock and roots.

"It is rather remarkable" (the report continues) "that in the soil about the roots of these plants, nearly 30 species of nematodes should be found, about 25 of which are new species. Two of these species have been shown to be injurious to the plants, one of them attacking the roots, and being found living parasitically on certain brown, rotten cavities, and the other being found between the sheathes of the leaves of the plant, and in some cases even at the very core, where the tissues appeared to be quite sound and white. It will therefore be seen that there are four separate causes for the diseases of these plants, viz., aphides or plant lice, a fungus causing rot in the root-stock, and two different species of nematodes.

"The remedies that are suggested in the present state of our knowledge, which, of course, is incomplete, are these:—

"i. That where the bananas are cultivated, a system of rotation should be adopted; that no attempt should be made to grow banana plants on the same ground continuously for a long series of years * * *

"ii. Judging from the specimens sent, the soil about the banana plants is infested to an extraordinary degree with nematodes, therefore, it is best, in cultivating, to plough deeply, or to occasionally subsoil the land. These nematodes attack the roots of plants, and exist largely within eight inches of the surface. As they become rarer as the depth of the soil increases, it follows that if the land be ploughed deep and thoroughly so as to turn the soil exactly bottom side up, a soil comparatively free from nematodes will be brought to the surface, and, at the same time, the nematodes which were near the surface are buried so deep that they can do much less damage than they could if left at the surface.

"iii. * * * The main difficulty in dealing with these plants is thought to be due to the attacks of the fungus mentioned above, and here the best remedy to recommend is great care in setting the new suckers, *i.e.*, in making new plantations. As pointed out, the presence of the fungus is indicated by discolouration in the root-stock. Now, when suckers are cut off from the old plant with a spade, they should be inspected, and all brown and rotten portions should be carefully removed, and all suckers from which these brown and discoloured portions cannot be removed without destroying the chances of growing, should be discarded."

CCXXXI.—MISCELLANEOUS NOTES.

From Mons. E. André, Kew has received in exchange a set of his South American Bromeliaceæ, numbering about 70 species. This is an important addition to the Herbarium, already fairly rich in a family commonly neglected by collectors on account of the difficulty in drying and the bulky nature of specimens.

The Rev. R. Baron, well known for the very large additions he has made to our knowledge of the flora of Madagascar, has forwarded a further collection of dried plants, consisting of 700 numbers. This collection is from a district previously unexplored by English collectors, namely the tropical region north of Antananarivo; and it doubtless contains a large number of novelties, new at least to the Kew Herbarium. The specimens are all that could be desired.

Flora of the "Barren Grounds," North Canada.—Mr. Warburton Pike, who has made a journey to the country north of the Great Slave Lake, in the Great Fish River region, between the lake and Franklin Bay to the north-east, has presented a small collection of dried plants brought thence by him. The common plants include *Vaccinium uliginosum, Cassiope tetragona, Andromeda polifolia, Phyllodoce taxifolia, Ledum palustre, Loiseleuria procumbens, Rhododendron lapponicum,* and *Kalmia glauca.*

Index Kewensis nominum omnium generum et specierum plantarum phanerogamarum, 1735–1885. The printing by the Clarendon Press of this work, prepared at Kew by Mr. Daydon Jackson and

assistants, under the superintendence of Sir Joseph Hooker, has been commenced, and will now be pushed on with all possible speed. It will greatly facilitate botanical work of every kind. Mr. Jackson has been engaged upon its preparation for upwards of 10 years, and the cost of it is derived from funds provided by the late Charles Darwin, F.R.S., and his family.

St. Helena appears to be unfortunate in the way of pests affecting cultivated plants. A short time ago specimens were received at Kew of the Cushion Scale Insect (*Icerya Purchasi*), one of the most deadly plant-parasites known. This was fully described in *Kew Bulletin*, 1889, p. 191 (with plate). The insect had apparently only lately been introduced to St. Helena, and it is hoped that the steps recommended to be taken will be successful in eradicating it.

A plant which has established itself in some places in St. Helena, and become a troublesome weed, is *Nothoscordum borbonicum*, Kunth. This is closely allied to the Alliums or Garlicks, and although a native of temperate and tropical America, has spread in many places in the old world. At St. Helena, the Governor states that "it spreads with "startling rapidity, and exterminates the grass and other vegetation. "The ground on being turned up presents a solid mass of bulbs to a "depth of six inches. It has been found impossible to separate the "bulbs by hand, as they range from the size of a pin's head to that of "a walnut. An experiment has been made of removing the earth to "the depth of the bulbs, and burning the whole, but this mode of "treatment is too costly." Again, mowing the plant has been found to be of no use.

A closely allied plant, *Nothoscordum striatum*, Kunth, a native of the Northern United States, has been found to be troublesome in the herbaceous beds at Kew. It is almost impossible to eradicate it, and from this experience it is easy to realise the difficulty found in dealing with a similar pest in a tropical country. One method that has been suggested, as so many others have failed, is to soak the ground, after the surface has been slightly loosened, with a liquid "weed-killer." This, however, is a very drastic method, and it cannot be done on a large scale, as it involves considerable expense, besides the abandonment of the ground for a year or two owing to the sterilising effect of the liquid.

A similar pest in tropical countries is the Nut-grass, *Cyperus rotundus*, L. This takes possession of some of the best soils in gardens, and becomes a most troublesome and persistent weed. In some cases by systematic weeding and giving constant attention, it has been found possible to keep the plant in check for a time. If, however, the smallest portion of the roots or tubers are left in the ground the plant soon reappears. It always looks green, and by means of the wide ramifications of its rhizomes, it appears to withstand the severest droughts. The occurrence of this plant as a troublesome weed in gardens, is noticed in reports from nearly every part of the eastern and western tropics, from the south of Europe, the Cape, and Australasia. A simple and effective means for getting rid of such pests, without recourse to expensive or drastic measures, would be of immense value to the tropical cultivator.

His Excellency Sir John Bates Thurston, K.C.M.G., Governor of the Fiji Islands, kindly forwarded to Kew in 1891 a quantity of tubers of *Tacca pinnatifida*, Forst. This is a perennial herbaceous plant, with a tuberous root, yielding South-sea Arrowroot. The flowers are greenish or brown in an umbel on the top of a leafless scape surrounded by an involucre of single bracts. The leaf-stalks are plaited into head-dresses. As a source of arrowroot the plant is of great value. The tubers when fresh resemble new potatoes, and contain a great deal of starch. Tacca arrowroot is preferable to any other in cases of dysentery and diarrhœa. A portion of the tubers received at Kew was distributed to each of the Botanical Institutions at Jamaica, Trinidad, and Lagos, West Africa, in order to establish so useful a plant in these parts of the world. Those retained for Kew have now flowered (January 1891), and a figure, with description, is in course of being prepared for the *Botanical Magazine*.

The demands received at Kew for seeds, plants, and cuttings of choice fruits for cultivation in the tropics show that considerable interest is being taken in selecting the best sorts and in cultivating them in a careful and systematic manner. The assistance rendered by Kew in this respect is necessarily confined to the smaller institutions, such as the newly-created Botanical Stations which have not as yet completed their organisation for regular exchanges with kindred institutions in other parts of the world. During the last two years large supplies of cuttings of selected grape vines and figs, seeds of dates and strawberries, and suckers of pine-apples and of bananas have been distributed to the Botanical Gardens in West Africa, Fiji, and the West Indies. Cuttings of grape vines and figs were obtained by the courtesy of the Council from the gardens of the Royal Horticultural Society at Chiswick. Others were obtained from the establishment of Messrs. Rivers and Son, at Sawbridgworth, Herts.

A review of the number of visitors at the Royal Gardens during recent years will prove of interest. The actual numbers for the five years, 1887–91, inclusive, are as follows :—

Year.	Sundays.	Week Days.	Total.
1887	489,483	657,220	1,146,703
1888	587,385	613,417	1,200,802
1889	659,800	826,256	1,486,056
1890	879,118	960,848	1,839,966
1891	697,200	676,553	1,373,753
Total	3,312,986	3,734,294	7,047,280

It will be noticed that the number of people who visit Kew yearly has now assumed considerable proportions. Taking the number recorded for the year 1890, which is the largest yet attained, the annual attendance of visitors is not far short of two millions. There was a falling off for

the year 1891, but this is clearly traceable to the generally wet and cold character of last summer.

The Royal Gardens at Kew were first opened to the public "for healthful recreation and instruction," soon after the appointment of Sir William Hooker as Director in 1841. This was only on week days. They were opened on Sundays from 2 to 6 p.m. in 1854. From 1878 the whole establishment has been open to the public from 10 a.m. on bank holidays.

The gradual increase in the attendance for each decennial period during the last 50 years, 1841–1891, inclusive, may be gathered from following record :—

Year.	Attendance.	Year.	Attendance.
1841 - - -	9,174	1871 - - -	577,084
1851 - - -	327,900	1881 - - -	836,676
1861 - - -	480,070	1891 - - -	1,373,753

If the figures for 1890 were adopted instead of those for 1891, the increase in the preceding 10 years would be almost exactly a million.

The highest week-day attendance yet recorded was on May 26, 1890 (a bank holiday), when the number of visitors reached 106,808. The highest Sunday attendance yet recorded was on the 30th August 1891, when the number of visitors reached 52,545.

Hooker's "*Icones Plantarum*" is devoted to the illustration of new plants of special botanic or economic interest. It was established by the late Sir William Hooker; and the first volume was published in 1837. The sale has never met the cost of production, and it was only through the substantial aid of the late George Bentham, F.R.S., that it was continued at irregular intervals until his death. One volume is now issued yearly at the cost of the Bentham Trustees; and the price has been fixed at four shillings each part, or sixteen shillings a volume. It is edited, under the authority of the Director of the Royal Gardens, by Professor D. Oliver, late Keeper of the Herbarium ; and the plants figured are selected from the collections constantly being received from various parts of the world. The first volume of the fourth series, or twenty-first of the whole work, is now complete. Each volume contains 100 plates, so that the total has reached 2,100. In order to place the work within the reach of every botanist the Bentham Trustees have decided to offer the ten volumes forming the third series at 5*l.* the set. Persons desirous of possessing the work should apply to Messrs. Dulau and Co., 37 Soho Square, London, W.